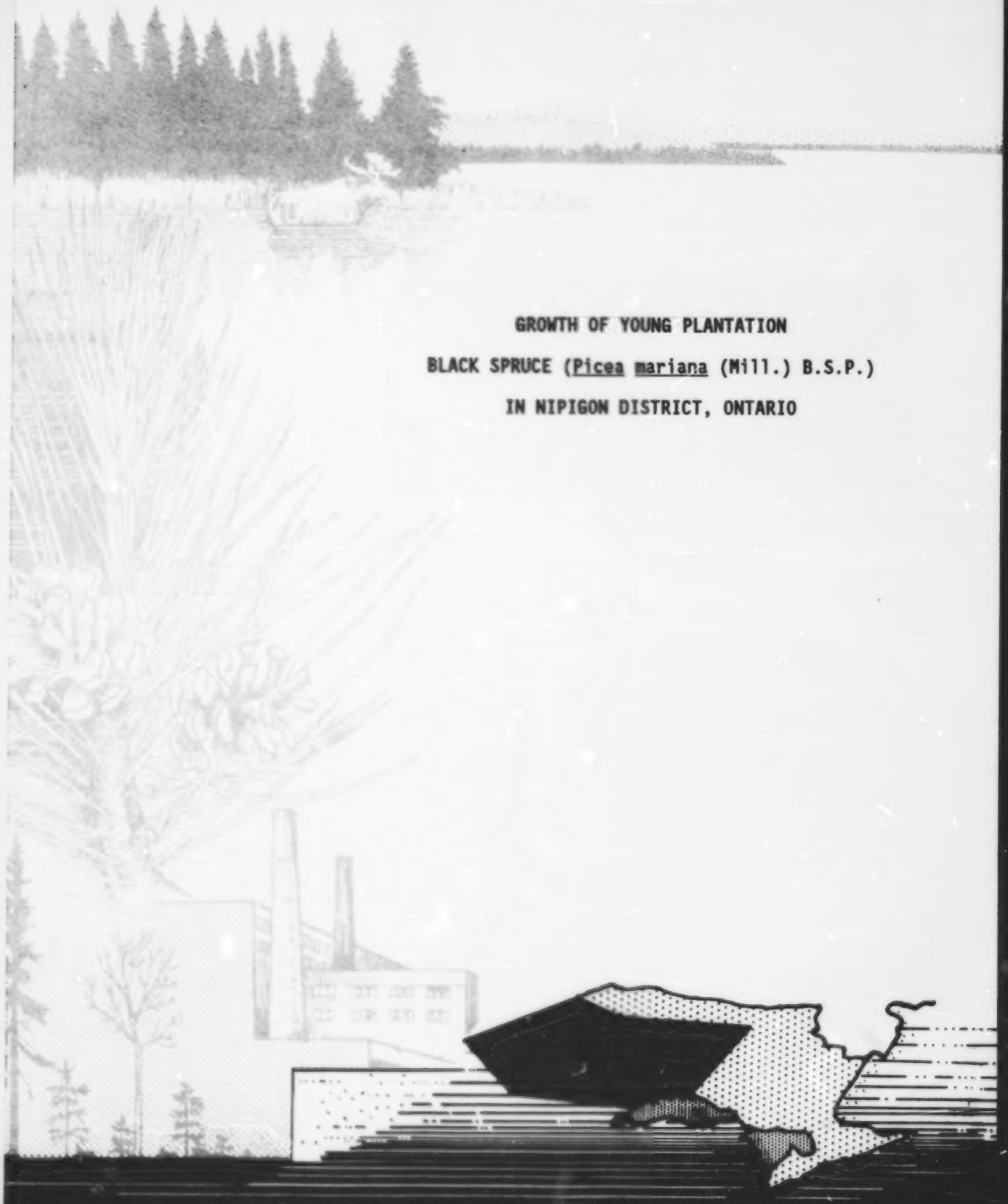

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by

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ABSTRACT

This paper reports on the early growth of two young black spruce (Picea mariana (Mill.) B.S.P.) plantations near Beardmore, Ontario in Nipigon District. Mensurational information was collected on ten plots at each of two plantations, the first near Limestone Lake, the second near Tyrol Lake. The results show that all plots meet or exceed the predicted growth of Site Class 1a black spruce (Plonski, 1975). Trees also appear to be maintaining the growth rates originally documented in 1979 by Gordon and Morrow (1979). Both plantations should be considered for a first thinning in the near future.

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INTRODUCTION

While plantation forestry has been practised in Ontario for several decades, it is only recently that data has been collected on the growth and structure of these plantations. It is to be expected that plantation growth will differ considerably from that of naturally occurring, fire-origin black spruce (Picea mariana (Mill.) B.S.P) stands. Early reports on the growth of black spruce plantations in Nipigon district have documented a generally lower stem density and as such have reported considerably increased diameter and height growth. The objective of this report is to provide additional mensurational data on these young black spruce plantations.

STUDY AREAS

Two plantations were studied - one at Limestone Lake and one at Tyrol Lake.

The Limestone Lake plantation is approximately 20 km north of Nipigon, Ontario. The soils range from silt to sand and are shallow to moderately deep over granitic bedrock with limestone outcrops (Table 1). Drainage varies from moderately-well to imperfect. The forests in the area were originally cut between 1937 and 1940; the area was subsequently burned in 1941 and again in 1948 and then replanted in 1960 with 2+2 and 3+2 black spruce. Other areas within this plantation were also planted to white spruce (Picea glauca (Moench.) Voss), jack pine (Pinus banksiana Lamb.) and red pine (Pinus resinosa Ait.). The initial spacing was 2 x 2 m. Planting was conducted in August and September using the "L" slit method without scalping. Little frost-heave damage occurred to the seedlings after the first season and consequently survival was excellent,

Table 1. Characteristics Of The Limestone Lake Plantation

Plot	Soil Texture[1] Surface	Sub-Surface	Drainage[2]	Moisture Regime	Slope %	Slope Position	Aspect
1	mS	fS	I	5	11	UPPER	NW
2	LfS	vfSL	I	3	1	MID	LEVEL
3	L	N/D[3]	N/D	N/D	8	MID	S
4	SiL	vfSL	N/D	N/D	1	UPPER	SW
5	LS	L	N/D	N/D	1	CREST	LEVEL
6	vfSL	vfSL	N/D	N/D	8	MID	W
7	SiS	LS	I	5	8	LOWER	SW
8	SL	SL	I	4	9	MID	E
9	SiL	L	I	4	11	UPPER	NW
10	fSL	LfS	I	3	5	LOWER	SW

[1] mS: medium sand; LfS: loamy fine sand; L: loam; SiL: silt loam; LS: loamy sand; vfSL: very fine sandy loam; SiS: silty sand; SL: sandy loam; fSL: fine sandy loam.

[2] I: imperfect.

[3] N/D: Soils could not be sampled to a sufficient depth to accurately assess these values.

ranging from 90 to 94%. First year height growth was vigorous, averaging approximately 7.5 cm with some trees growing as much as 15 cm (Koski, pers. comm.). An inspection conducted in 1966 (Marek, pers. comm.) revealed a survival of approximately 3500 stems per hectare. The spruce averaged 135 cm in height with some individuals attaining a height of 180 cm. There was some damage to the leaders by whipping caused by coppice poplar (Populus spp.), hazel (Corylus

spp.) and cherry (Prunus spp.). A hand cleaning operation in the summer of 1966 removed the source of this problem; a second hand cleaning operation was conducted in 1973.

The Tyrol Lake plantation is approximately 40 km north of Beardmore, Ontario and is predominantly black spruce with a minor component of white spruce. The soils range from silt to loamy sand, shallow to moderately deep, moderately-well to imperfectly drained (Table 2). This area was selectively harvested for sawlogs during the early 1950's. It was subsequently burned by wildfire during the summer of 1956. Planting was done in August and September of 1961 using 2+2 white spruce at 2.1 x 2.1 m spacing and black spruce at 1 x 1 m spacing. The "L" slit method was used without scalping. Estimated first year survival for the white spruce was 97%, and 76% for the black spruce. The high mortality of the black spruce was not unexpected due to the condition of the outplanted stock. This was the reasoning for the tight initial spacing. Survival estimates after 5 years were 90% for the white spruce and 80% for the black spruce. A hand cleaning operation of deciduous tree species was conducted in 1976.

Employing the black spruce site productivity key for Northwestern Region (Buse and Baker, 1991) the estimated Site Index for both plantations is 16.0 m at 50 years.

Both plantations are typified by the vegetation type V-33 (Black Spruce/Feathermoss) and soil type SS-8 (Shallow - Moderately Deep/Mottles - Gley) (Sims et al., 1989), although the Forest Ecosystem Classification is meant for natural stands rather than plantations. The authors do not suggest that any inferences of site quality or productivity be implied from these classifications.

Table 2. Characteristics of the Tyrol Lake Plantation

Plot	Soil Texture[1] Surface	Sub-Surface	Drainage[2]	Moisture Regime	Slope %	Slope Position	Aspect
11	Si[1]	N/D[3]	I	5	7	MID	E
12	Si	Si	I	4	6	LOWER	LEVEL
13	L	N/D	N/D	N/D	7	CREST	S
14	SiL	N/D	N/D	N/D	11	MID	S
15	LvfS	LvfS	I	5	16	MID	S
16	SiL	SiL	I	4	10	MID	SSW
17	SiL	N/D	N/D	N/D	10	MID	SW
18	L	N/D	N/D	N/D	17	UPPER	S
19	L	L	N/D	N/D	4	TOE	NE
20	SiL	N/D	N/D	N/D	6	MID	SSW

[1] Si: silt; L: loam; SiL: silt loam; LvfS: loamy very fine sand.

[2] I: imperfect.

[2] N/D: Soils could not be sampled to a sufficient depth to accurately assess these values.

METHODOLOGY

Ten plots of 4.5 m radius (63.6 m^2) were established in September of 1990 in each plantation. Plots were chosen to represent a variety of aspects and slope positions. All trees in the plots were measured for age at breast height, DBH and height. Annual height increment measurements were taken for three years above breast height. This information will be used in an attempt to develop a growth intercept model to estimate site quality similar to models

developed for red pine (Alban, 1979; Brown and Duncan, 1990). Information was also collected on the herb and shrub communities as well as soil texture and depth to mottles where possible.

Three trees from each plot (dominant, co-dominant and mean) were destructively sampled for stem analysis. There was a small component of white spruce in several of the Tyrol Lake plots. These were included in the general summaries but were not sampled for stem analysis.

RESULTS AND DISCUSSION

For all measured parameters the plantation growth meets or exceeds the listed values for Site Class 1a (Plonski, 1981). Tables 3 and 4 provide stand data and comparison to Plonski's (1981) values. Heights are within the expected range but basal area and gross total volume are similar to the values listed for trees 35 to 40 years old. These higher-than-expected values are likely due to the lower stem density, compared to Plonski's tables.

Growth parameters reported in this study are similar to those reported by Bell et al. (1990) in variable density yield tables for Site Class 16.0 m (at 50 years). However, Bell et al. (ibid.) reported stocking density of 2199 stems/ha and estimated volume to be 111 m^3/ha. This is considerably lower than the densities and volumes reported in this study (3239 stems/ha., 184.5 m^3/ha at Limestone Lake; 4496 stems/ha, 191.1 m^3/ha. at Tyrol Lake). These differences may become less dramatic as the mortality of suppressed trees increases.

Table 3. Stand Characteristics Of The Limestone Lake Plantation - Mean Values

Plot	D.B.H (cm)	Height (m)	Age @BH (y)	Basal Area (m^2)	Volume (m^3 ha^{-1})	Density (Stems ha^{-1})	3 Year Point Intercept (cm)
1	12.2	9.8	24	28.7	138.7	2358	111.4
2	12.4	9.6	23	38.8	183.5	3144	115.8
3	11.1	9.6	23	44.9	217.7	4401	121.4
4	14.0	10.8	24	46.5	239.4	2987	124.6
5	13.9	11.0	24	43.6	227.8	2829	116.6
6	12.1	10.3	24	41.0	205.4	3458	112.9
7	12.0	10.1	24	46.0	227.2	3930	123.6
8	12.8	8.2	22	29.7	124.4	2201	101.4
9	12.0	8.9	22	35.4	157.5	2987	110.4
10	9.87	6.9	20	33.5	123.3	4090	96.5
MEAN	12.1	9.5	23	38.8	184.5	3239	113.8
SITE CLASS 1A *		9.4		31.0	130		
SITE CLASS 1 *	5.9	6.7		18.5	64	6721	

* At 30 years. Adapted from Plonski, 1981.

Table 4. Stand Characteristics Of The Tyrol Lake Plantation - Mean Values

Plot	D.B.H. (cm)	Height (m)	Age @BH (y)	Basal Area (m^2)	Volume (m^3 ha^{-1})	Density (Trees ha^{-1})	3 Year Point Intercept (cm)
11	11.4	11.1	23	46.2	244.8	4401	123.3
12	10.9	10.2	23	46.2	240.6	4873	102.0
13	11.2	9.1	21	44.9	204.0	4401	108.3
14	9.4	9.3	23	38.2	171.6	5344	117.0
15	10.5	9.3	22	40.5	189.1	4401	92.9
16	10.3	9.4	22	35.7	163.8	4087	112.5
17	11.6	9.8	22	44.0	210.6	4087	107.7
18	9.9	8.4	21	34.9	151.0	4244	106.1
19	11.1	9.0	22	37.4	167.2	3773	117.8
20	9.3	9.0	22	40.4	168.8	5344	107.8
MEAN	10.5	9.5	22	40.8	191.1	4496	111.4
SITE[1] CLASS 1A		9.4		31.0	130		
SITE[1] CLASS 1	5.9	6.7		18.5	64	6721	

[1] At 30 years, from Plonski (1981).

Gordon and Morrow (1979) published growth parameters for black spruce in the Nipigon-Beardmore area. They found the range in height at 21 years to be 4.8 m to 6.5 m, with both the Tyrol Lake and Limestone Lake plantations exhibiting similar variations in height. Armson (1975) proposed that large planting stock was capable of maintaining higher average height growth than smaller stock and suggested that using more uniform planting stock would minimize this variation in height. It now appears that the smaller trees have been suppressed for several years and are in a state of decline. As these trees undergo mortality, adjacent trees will likely exhibit accelerated growth until crown closure is complete.

Mean annual height growth for both study areas was 0.32 m/year. This is within the normal range for Site Class 1a. Gordon and Morrow (1979) also reported normal incremental growth (current annual height increment = 0.45 m/year), although they observed that the curves appeared to be flattening out. It appears that the trees may be sacrificing height growth for diameter increase.

Information collected in the fall of 1984 at the Limestone Lake plantation (Day and Marek, pers. comm.) showed mean annual height growth to be 0.36 m/year, the mean spacing interval to be 1.81 m and the stand density to be 3039 stems/ha. It was suggested that at this rate of growth and stand density the plantation would require a first thinning in 1990. A preliminary examination of the stem analysis data revealed that the growth within both plantations is not slowing to any significant extent. However, it is recommended that both the Limestone Lake and Tyrol Lake plantations be marked for a first thinning.

An analysis of variance was conducted on the 3-year point intercept data. A strong linear relationship (alpha=0.99) between the cumulative growth of 3 years, beginning at the first internode above breast height, and the height at 30 years exists. However, only a small amount of the variation can be accounted for by the point intercept alone (R^2=0.20). Due to the small variation in height and age of the stands sampled a more substantive model cannot be developed at this time. However, it appears promising that a point intercept model can be developed to estimate site class.

SUMMARY

Current growth in both plantations continues to exceed the predicted potential. As the growth does not appear to be slowing, it is difficult to predict the site potential. Bell et al. (1990) suggest that stands with a high initial density will tend to exhibit a rapid increase in gross total volume but that this will eventually slow and produce similar yields as stands of lower densities.

Both plantations should be considered for a first thinning in the near future to encourage the exceptional growth. Continued monitoring of these plantations is also recommended to expand and maintain the current data base.

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